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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/558,053 04/26/00 APYAMA

EXAMINER

MM71/0829
OBLON SPIVAK MCCLELLAND MAIER & NEUSTADT
1755 JEFFERSON DAVIS HIGHWAY
FOURTH FLOOR
ARLINGTON VA 22202

ART UNIT	PAPER NUMBER
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DATE MAILED:

08/29/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/558,053

Applicant(s)

APYAMA ET AL.

Examiner

Kurt M. Eaton

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 August 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 29-40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 29-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

1. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

Examiner's Comments

2. Applicant contends it was agreed that the combination of claims 28, 29, and 41 would distinguish over the prior art of record and of Chow et al. (U.S. Patent No. 4,789,648), a reference newly cited during an interview held on 7/20/01.

The examiner respectfully submits however, that an agreement was reached concerning the inability of the Cochran reference to teach what was claimed. Furthermore, no indication of patentability of the aforementioned claims over the Chow et al. reference was made.

Specification

3. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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5. Claims 29, 31, and 40 are rejected under 35 U.S.C. 102(b) as being anticipated by Chow et al. (U.S. Patent No. 4,789,648).

In re claim 29, Chow et al. (herein referred to as Chow) shows in Figures 2-6, for example, forming a first insulating film (5) on a semiconductor substrate (3); forming a second insulating film (6) on the first insulating film, wherein the second insulating film is made of a material different from that of the first insulating film and having a thickness smaller than that of the first insulating film; forming a third insulating film (8) on the second insulating film and having a thickness larger than that of the second insulating film; forming a groove in a region of the third insulating film, in which a wiring is to be formed, wherein the groove has a bottom to which the second insulating film is exposed; forming a metal wiring (9) in the groove; and removing a part of that portion of the second insulating film which is exposed to the groove, and a part of the first insulating film under the portion of the second insulating film, and thus forming a contact hole reaching to the semiconductor substrate, wherein the contact hole is buried with a metal in the step of forming a metal wiring in the groove {column 2, line 67 - column 4, line 7}.

In re claim 31, Chow shows wherein the metal wiring is formed of Al {column 2, line 67 - column 4, line 7}.

In re claim 40, Chow shows in Figures 2-6, for example, forming a first insulating film (5) on a semiconductor substrate (3); forming a second insulating film (6) on the first insulating film, wherein the second insulating film is made of a material different from that of the first insulating film and having a thickness smaller than that of the first insulating film; forming a third insulating film (8) on the second insulating film and having a thickness larger than that of the second insulating film; forming a groove in a region of the third insulating film having a bottom including the second insulating film; forming wiring material (9) in the groove, wherein the step of forming the groove

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includes etching through the second insulation film to expose the first insulation film while leaving a remaining second portion of the second insulation film and removing a third portion of the first insulation film to expose the substrate while leaving a remaining fourth portion of the first insulation film {column 2, line 67 - column 4, line 7}.

Claim Rejections - 35 USC § 103

6. Claim 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chow in view of Cochran.

In re claim 30, Chow wherein the first insulating film is substantially formed of SiO_2 , wherein the second insulating film is substantially formed of Al_2O_3 , and wherein the third insulating film is substantially formed of SiO_2 {column 2, line 67 - column 4, line 7}.

Chow fails to show wherein the second insulating film is substantially formed of Si_3N_4 .

Cochran shows in Figures 1-5 forming a first insulating film (23) substantially formed of SiO_2 on a semiconductor substrate (21); forming a second insulating film (25) on the first insulating film, wherein the second insulating film is made of a material different (i.e., Si_3N_4 , substantially) from that of the first insulating film, has a thickness smaller than that of the first insulating film, and has a different etch selectivity with respect to the first insulating film; forming a third insulating film (27) substantially formed of SiO_2 on the second insulating film, wherein the third insulating film is made of a material different from that of the second insulating film, has a thickness larger than that of the second insulating film, and has a different etch selectivity with respect to the second insulating film; forming a groove in a region of the third insulating film, in which a wiring is to be formed, wherein the groove is formed by etching the third insulating layer and then the second insulating layer; and forming a metal wiring (37) in the groove {column 3, line 4 – column 4, line 67}.

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the second insulating film of Chow out of Si_3N_4 instead of Al_2O_3 since, as evidenced by Cochran, Si_3N_4 is a material well known in the art that may be interposed between two insulating layers substantially formed of SiO_2 and that may act as an etch stop layer in the formation of grooves in overlying SiO_2 and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art.

7. Claims 32-34, 36, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chow in view of Mu.

In re claims 32, 33, 36, and 37, Chow substantially discloses the invention as claimed but fails to show the step of forming a barrier metal film of Nb on inner surfaces of the groove and the contact hole.

Mu teaches wherein a barrier layer made of Nb is formed within a groove in a dielectric layer prior to deposition of Al material within the groove {column 4, lines 38-46}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a Nb barrier layer metal film on inner surfaces of the groove and the contact hole of Chow prior to formation of the Al metal wiring since, as evidenced by Mu, Nb is a known material that acts as a barrier layer to aluminum material and it is well known within the art that a barrier layer would help maintain the integrity of the insulating films surrounding the Al metal wiring by preventing atoms of the metal wiring from diffusing into the insulating films and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art.

In re claim 34, Chow substantially discloses the invention as claimed but fails to show wherein the metal wiring is formed of Cu.

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Mu teaches wherein Cu and Al are both known materials that may be used in metal wiring structures {column 4, lines 38-46}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the metal wiring of Chow out of Cu instead of Al since, as evidenced by Mu, Cu is a known material that may be used in metal wiring structures and may substitute Al and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art. Additionally, Cu is a known material that has a lower resistivity than Al. Thus replacing Al within the metal wiring of Cochran with Cu would increase the performance of the device.

8. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chow in view of Roth.

In re claim 35, Chow further includes a step of forming a thin passivation insulator on the third insulating film {column 4, lines 1-7}.

Chow fails to show wherein the thin passivation insulator is formed as a carbon film.

Roth teaches wherein carbon is a known material that may be used as a thin passivation insulator {column 3, lines 24-60}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the top etch stop layer of Chow out of carbon since, as evidenced by Roth, carbon is a known material that may be used as a thin passivation layer and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art.

9. Claims 38 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chow in view of Roth as applied to claim 35 above, and further in view of Mu, as applied to claim 33 above.

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Chow in view of Roth substantially discloses the invention as claimed but fails to show further forming another barrier metal film on the metal wiring, wherein the another barrier metal film is formed of Nb.

Mu teaches wherein a barrier layer made of Nb is formed within a groove in a dielectric layer prior to deposition of Al material within the groove {column 4, lines 38-46}. Mu also teaches in Figure 9 formation of an equivalent metal wiring structure formed in the groove and in the contact hole of Chow is repeated such that a second level of metal wiring filling a second contact hole and a second groove is formed over the first metal wiring structure {column 8, lines 39-67}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a Nb barrier layer metal film on inner surfaces of the groove and the contact hole of Chow in view of Roth prior to formation of the Al metal wiring since, as evidenced by Mu, Nb is a known material that acts as a barrier layer to aluminum material and it is well known within the art that a barrier layer would help maintain the integrity of the insulating films surrounding the Al metal wiring by preventing atoms of the metal wiring from diffusing into the insulating films and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art. It also would have been obvious to form another barrier metal film made of Nb on the metal wiring structure of Chow in view of Roth and Mu by forming a second level of metal wiring structures including a second groove and a second contact hole since, as suggested by Mu, formation of second level metal wiring structures over previously formed metal wiring structures is well known within the art and would require only duplication of essential working steps and mere duplication of essential working steps involves only routine skill in the art.

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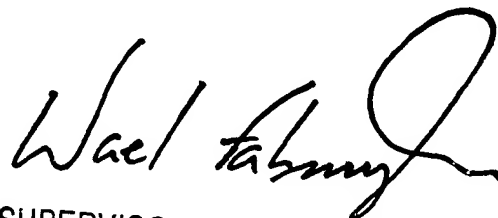
Response to Arguments

10. Applicant's arguments with respect to claims 29-40 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

11. Paper related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 308-7722** or **-7724**. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

Any inquiry concerning this communication of earlier communication from the examiner should be directed to **Kurt Eaton** at **(703) 305-0383** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via kurt.eaton@uspto.gov.



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